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Assessment of Phytoplankton Diversity and Dynamics of a Lentic Water Body of Belur Rail Station Area with Reference to Pollution Status

SUBHABRATA GHOSH AND JAI PRAKASH KESHRI

Phycology Laboratory, Center for Advanced Studies in Botany, The University of Burdwan
Burdwan 713104, India
E-mail : jpkeshri@indiatimes.com

Abstract

A study was carried out in a lentic water body (a pond) near Belur rail station area on phytoplankton diversity, density and distribution in different seasons and their relationship with pollution level of that particular lacustrine ecosystem. A total of 30 phytoplankton taxa belonging to Chlorophyceae (13), Cyanophyceae (6), Bacillariophyceae (8) and Euglenophyceae (3) were recorded. Highest number of species was present in pre-monsoon (24) and lowest in monsoon (14). Chlorophycean representatives were present in highest number (13) and members of Euglenophyceae with least representation (3). Shannon-Wiener diversity index (H/) value (2.598) was found to be the highest during pre-monsoon while maximum Simpson's dominance (λ) value (0.174) was recorded during monsoon, Mrgalef's index of richness (R) value (3.538) was highest in pre-monsoon and Pielou's evenness index (E) value (0.890) was highest in monsoon. The present study indicates light to moderate pollution status of the water body.
Key words : Phytoplankton, Lentic water body, Pollution status.

Phytoplankton is one of the suitable bio-monitoring tools to detect environmental changes. This type of study includes the use of biotic components of an ecosystem to express periodic changes in the environmental quality and stability of an ecosystem. Industrialization and huge agricultural practices mainly contributing the polluted and toxic status of the aquatic ecosystems. Pollutants bring about a drastic change in physical and chemical quality of water which also changes the biotic elements of the concerned water body. Clean water would encourage a great variety of organisms, whereas polluted water reduces the diversity of organisms but increases the number of individuals of few dominant forms (1). A change in phytoplankton community structure markedly affects the species diversity (2). In this investigation an attempt was made to study the diversity and dynamics of phytoplankton during the period from November 2008 to July 2009 and establishing its relationship with water pollution.

Methods

Phytoplankton samples were collected between 0900 to 1000 hours in 400 ml amber color bottles and fixed with Lugol's iodine solution in 100 : 1 ratios. Lugol's iodine colors the phytoplankton and makes those minute organisms heavy, which results, a faster sedimentation. The supernatant part was pipetter out and the sample being concentrated to 4 ml. for analysis. Drop count method (3) was followed for phytoplankton enumeration and the phytoplankton densities were expressed as organisms per liter.

Physico-chemical parameters such as water-temperature, pH, conductivity, dissolved oxygen, nitrate, phosphates and potassium were analysed by standard method (4). The community structure was analysed by Shannon-Wiener index of diversity (H/), Simpson's dominance index (λ), Margalef's richness index (R) and Pielou's evenness index (E) with the help of DINDEX, ver 4.0 software. Pearson correlation coefficient was used to explain the relationship between phytoplankon density and different environmental variables by using SPSS 11.0. Algal monographs by Smith (5) and Prescott (6, 7) were followed to identify phytoplankton. The pollution status of the water body was described by using the relationship proposed by Wilhm Dorris (8) and Staub et al. (9).

Results and Discussion

Phytoplanktons play a pivotal role in the multidimensional biological spectrum of lentic fresh water

Table 1. Phytoplankton taxa in the study site under post-monsoon, pre-monsoon and monsoon time frame. + = presen, - = absent.

	Material	Post-monsoon	Pre-monsoon	Monsoon
1	*Chlorella* sp.	-	+	-
2	*Scenedesmus* sp.	+	+	-
3	*Mesotaenium* sp.	-	+	+
4	*Ankistrodesmus* sp.	+	-	+
5	*Coelastrum* sp.	-	+	+
6	*Pandorina* sp.	+	+	+
7	*Roys* sp.	+	+	+
8	*Closterium* sp.	+	-	+
9	*Triploceros* sp.	-	+	-
10	*Strastrum* sp.	+	+	+
11	*Desmidium* sp.	-	+	+
12	*Characium* sp.	-	+	-
13	*Sorastrum* sp.	-	+	-
14	*Aphanocapsa* sp.	+	-	-
15	*Merismopedia* sp.	+	+	+
16	*Arthospira* sp.	+	+	+
17	*Oscillatoria* sp.	+	+	+
18	*Lyngbya* sp.	-	+	-
19	*Wollea* sp.	+	-	-
20	*Synedra* sp.	-	+	-
21	*Achanthes* sp.	+	+	-
22	*Navicula* sp.	+	-	-
23	*Pinnularia* sp.	+	+	+
24	*Surirella* sp.	+	+	+
25	*Gomphonema* sp.	-	-	+
26	*Cymbella* sp.	-	+	-
27	*Eunotia* sp.	-	+	-
28	*Phacus* sp.	+	+	-
29	*Lepocinclis* sp.	-	+	+
30	*Trachelomonas* sp.	-	+	-

bodies. They provide information on the ecological disturbance caused by a number of physico-chemical factors, sewage pollutants and various other man-made factors. A total of 30 phytoplankton taxa were recorded from the study side of while 13 belong to Chlorophyceae, 6 to Cyanophyceae, 8 to Bacillariophyceae and 3 to Euglenophyceae.Highest representation of species was recorded in pre-monsoon (24), followed by that in post-monsoon (16) and monsoon (14) respectively (Table 1). Phytoplankton density was highest in pre-monsoon (22.162/liter) followed by monsoon (12,131/liter) and post-monsoon (10,630/liter) (Table 2). Physico-chemical properties of water were depicted in Table 2. Pearson correlation matrix was used to evaluate the effect of physico-chemical parameters of water on the dynamics of phytoplankton density (Tables 3 to 5). Phytoplankton density describes positive correlation with water temperature, nitrates and phosphates and negative correlation with pH, conductivity, dissolved oxygen and potassium. Percentage composition of phytoplankton that explained members of Chlorophyceae were dominant (37.5, 45.84 and 50%) and Euglenophycean representatives with lowest percentage (6.25, 12.5 and 7.14%) for post-monsoon, pre-monsoon and monsoon respectively.

Table 3. Percentage composition of phytoplankton (%).

Phytoplankton	Post-monsoon	Pre-monsoon	Monsoon
Chlorophyceae	37.5	45.84	50
Cyanophyceae	31.25	16.66	21.42
Bacillariophyceae	25	25	21.44
Euglenophyceae	6.25	12.5	7.14

Species diversity is the reflection of both the species number and the evenness of their distribution (10). In the present study, lower value of evenness index was noticed at the time of low species diversity during the monsoon period and higher evenness value was noticed at higher diversity index value at post-monsoon also. But in pre-monsoon higher diversity index value corresponded to lower evenness index value. This was probably due to uneven distribution of individuals. Dominance index is another important component of species diversity, used to establish the phytoplankton structure of different habitats. Here it was observed that dominance of spe-

Table 2. Season wise water quality parameters and amount of phytoplankton density.

Season	Water temperature (C)	pH	Conductivity (μ s/cm)	Dissolved Oxygen (mg/l)	Nitrate (mg/l)	Phosphates (mg/l)	Potassium (mg/l)	Phytoplankton density/l
Post-monsoon	23	7.5	250	7.3	1.16	0.240	17	10630
Pre-monsoon	31	6.7	224	6.9	1.82	0.365	15	22162
Monsoon	27	7	260	7.2	1.30	0.318	13	12131

Table 4. Seasonal variation of diversity indices during November 2008 to July 2009.

Diversity index	Post-monsoon	Pre-monsoon	Monsoon
Shannon-Weaver index (H')	2.469	2.598	2.169
Simposon's Dominance index (λ)	0.110	0.106	0.174
Margalef's Richness index (R)	2.601	3.538	2.204
Pielou's Evenness index (E)	0.890	0.817	0.821

Table 5. Correlation matrix among the physico-chemical properties and phytoplankton density of the lentic water body during the study period. * = Correlation is significant at 0.5 level (2-tailed) ** = Coorrelation is significant at 0.01 level (2-tailed).

	Phytoplankton density/l	Water temp (C)	pH	Conductivity (µs/cm)	Dissolved oxygen (mg/l)	Nitrates (mg/l)	Phosphates (mg/l)	Potassium (mg/l)
Phytoplankton density/l								
Water temperature (°C)	0.799948							
pH	-0.85411	-0.37115						
Conductivity (µs/cm)	-0.75989	-0.99795	0.310947					
Dissolved oxygen (mg/l)	-0.9925	-0.72058	0.911293	0.67471				
Nitrates (mg/l)	0.996583	0.747653	-0.89415	-0.7036	-0.9992*			
Phosphates (mg/l)	0.854699	0.372204	-1**	-0.3120	-0.91176	0.894655		
Potassium (mg/l)	-0.1197	0.5	0.61859	-0.5544	0.240192	-0.20129	-0.6177	

cies decreased the species diversity with the uneven distribution of other species. Further, it has been found that when the dominance index was high, evenness index was low and vice-versa. For example when the evenness index value (0.890) in post-monsoon season the dominance index was showing its value 0.110. These observations prove the relationship, dominance index as the opposite of evenness index (11). Wilhan and Dorris (8) have proposed a relationship between species diversity and pollution status of a water body as, species diversity value > 3 = clean ; 1 - 3 = moderately polluted and < 1 = heavily polluted. Staub et al. (9) proposed another scale of pollution in terms of species diversity which is somewhat different from Wilham and Dorris (8) as species diversity value 3.5—4.5 = slight pollution ; 2.0 —3.0 = light pollution ; 1.0—2.0 = moderate pollution and 0.0–1.0 = heavy pollution. So from these relationship it may be said that light to moderate pollution level was detected in the present water body.

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